

## CLAIMS

## 1. A rotary solenoid comprising:

a rotor, which has a center axis, wherein at least two permanent magnets are located on the rotor, and polar axes of the permanent magnets are positioned about the center axis at predetermined angular locations;

a stator that is located about the rotor, wherein the stator includes pole parts, the number of which matches the number of permanent magnets, and a coil is wrapped about each pole part, wherein polar axes of the pole parts are positioned about the center axis at predetermined angular locations, and the rotor is driven in a predetermined angular range by magnetic fields induced by induction currents in the coils and by magnetic fields of the permanent magnets, wherein the angular locations of the permanent magnets and the angular locations of the pole parts are mismatched such that there is no position of the rotor at which the polar axes of the permanent magnets are radially aligned with the polar axes of the pole parts.

2. A rotary solenoid according to claim 1, wherein the stator includes at least two pairs of pole parts and the rotor includes at least two pairs of permanent magnets.

3. A rotary solenoid according to claim 1, wherein the polar axes of the pole parts are uniformly distributed about the axis of

the rotor, and the polar axes of the permanent magnets are non-uniformly distributed about the axis of the rotor.

4. A rotary solenoid according to claim 1, wherein the polar axes of the pole parts are separated from one another by equal angular intervals, and the polar axes of the permanent magnets are separated from one another by unequal angular intervals.

5. A rotary solenoid according to claim 1, wherein the distribution of the permanent magnets on the rotor is imbalanced.

6. A rotary solenoid comprising:

a rotor, which has a center axis, wherein the rotor includes at least two permanent magnetic polar axes at predetermined angular locations;

a stator that is located about the rotor, wherein the stator includes electromagnetic poles, each of which has a polar axes, and the number of the electromagnetic poles on the stator matches the number of permanent magnetic polar axes on the rotor, wherein the polar axes of the electromagnetic poles are positioned about the axis of the rotor at predetermined angular locations, and the rotor is driven in a predetermined angular range by magnetic fields created by the electromagnetic poles and by permanent magnetic fields of the rotor, wherein the angular locations of the permanent magnetic polar axes and the angular locations of the polar axes of the electromagnetic

poles are mismatched such that there is no position of the rotor at which the permanent magnetic polar axes of the rotor are radially aligned with the polar axes of the electromagnetic poles.

7. A rotary solenoid according to claim 6, wherein the stator includes at least two electromagnetic poles and the rotor includes at least two pairs of permanent magnetic polar axes.

8. A rotary solenoid according to claim 6, wherein the polar axes of the electromagnetic poles of the stator are uniformly distributed about the axis of the rotor, and the permanent magnetic polar axes are non-uniformly distributed about the axis of the rotor.

9. A rotary solenoid according to claim 6, wherein the polar axes of the electromagnetic poles are separated from one another by equal angular intervals, and the permanent magnetic polar axes are separated from one another by unequal angular intervals.

10. A rotary solenoid according to claim 6, wherein the distribution of the permanent magnetic polar axes on the rotor is asymmetrical.